A.D. 1858, *2nd June.* N° 1239.

Electric Telegraphs, &c.

LETTERS PATENT to Charles Wheatstone, of Hammersmith, in the County of Middlesex, for the Invention of "IMPROVEMENTS IN ELECTRIC TELEGRAPHS, AND IN APPARATUS CONNECTED THEREWITH."

Sealed the 2nd August 1858, and dated the 2nd June 1858.

PROVISIONAL SPECIFICATION left by the said Charles Wheatstone at the Office of the Commissioners of Patents, with his Petition, on the 2nd June 1858.

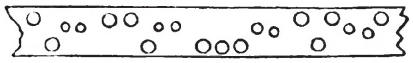
I, CHARLES WHEATSTONE, of Hammersmith, in the County of Middlesex, do hereby declare the nature of the Invention for "IMPROVEMENTS IN ELECTRIC TELEGRAPHS, AND IN APPARATUS CONNECTED THEREWITH" to be as follows:—

My Invention consists of a new combination of mechanism for the purpose of transmitting through a telegraphic circuit messages previously prepared, and causing them to be recorded or printed at a distant station. Long strips or ribbons of paper are perforated by a machine constructed for the purpose, with apertures grouped to represent the letters of the alphabet and other signs. A strip thus prepared is placed in an instrument, associated with a rheomotor (or source of electric power), which on being set in motion moves it along, and causes it to act on two pins in such manner that when one of them is elevated the current is transmitted to the telegraphic circuit in one direction, and when the other is elevated it is transmitted in the opposite direction; the elevations and depressions of the pins are governed by the apertures and

intervening intervals. These currents, following each other indifferently in the two opposite directions, act upon a printing or writing instrument at a distant station, in such manner as to produce corresponding marks on a ribbon of paper moved by appropriate mechanism.

I will proceed to describe more particularly the several parts of this telegraphic system, observing, however, that each part has its independent originality, and may be associated with other apparatus already known.

The first improvement consists of an instrument for perforating the slips of paper with the apertures in the order required to form the message. The slip of paper passes through a guiding groove, at the bottom of which an opening is made sufficiently large to admit of the to-and-fro motion of the upper end of a frame containing three punches, the extremities of which are in the same transverse line. Each of these punches is capable of being separately elevated by an appropriate finger key. By the pressure of either finger key, besides the elevation of its corresponding punch in order to perforate the paper, two different movements are successively effected, first, the raising of a clip which holds the paper firmly in its place, and, secondly, the advancing motion of the frame containing the three punches, by which the punch which is raised carries the ribbon of paper forward the proper distance during the reaction of the key consequent on the removal of the pressure; the clip first fastens the paper, and then the frame falls back to its normal position. The two external keys and punches are employed to make the holes which grouped together represent letters and other characters, and the middle punch to make holes, which mark the intervals between the letters. The perforations in the slip of paper appear thus,—



The second improvement consists of an apparatus, which may be called the transmitter, the object of which is to receive the slips of paper prepared by the previously described instrument or perforator, and to transmit the currents produced by a voltaic battery or other rheomotor, in the order and direction corresponding to holes perforated in the slip; this it effects by mechanism somewhat similar to that by which the perforator performs its functions. An eccentric produces and regulates the occurrence of three distinct movements, 1st, the to-and-fro motion of a small frame, which contains a groove fitted to receive a slip of paper, and to carry it forward by its advancing motion; 2nd, the elevation and depression of a spring clip, which holds the slip of paper firmly during the receding motion, but allows it to move freely during the advancing motion; 3rd, the simultaneous elevation of three wires placed

parallel to each other, resting at one of their ends on the axis of the eccentric, and their free ends entering corresponding holes in the grooved frame; these three wires are not fixed to the axis of the eccentric, but each of them rest against it by the upward action of a spring, so that when a light pressure is exerted on the free ends of either of them, it is capable of being separately depressed. When the slip of paper is not inserted, and the excentric is in action, a pin attached to each of the external wires passes during each advancing and receding motion of the frame from contact with one spring into contact with another spring, and an arrangement is adopted, by means of insulations and contacts properly applied, by which, while one of the wires is depressed and the other remains elevated, the current passes from the voltaic battery to the telegraphic circuit in one direction, and passes in the other direction, when the wire before elevated is depressed, and vice versa, but while both wires are simultaneously elevated or depressed, the passage of the current is interrupted. When the prepared slip of paper is inserted in the groove, and moved onwards, whenever the end of one of the wires enters an aperture in its corresponding row, the current passes in one direction, and when the end of the other wire enters an aperture of the other row it passes in the other direction; by this means the currents are made to succeed each other automatically in the proper order and direction to give the requisite variety of signals. The middle wire only acts as a guide to the paper during the cessation of the currents.

The wheel which drives the eccentric may be turned by hand, or by the application of any motive power. Instead of a voltaic battery, a magneto-electric or an electro-magnetic machine may be employed as the source of electric power. In this case the transmitter and the magneto-electric or electro-magnetic machine form a single apparatus moved by the same power, and they are so adapted to each other, that the shocks or currents are produced at the moments the pins of the transmitter enter the apertures of the perforated paper.

The transmitters just mentioned require only a single wire of communication, and currents in both directions are available for printing the signals; but in some cases it may be advantageous to employ two telegraphic wires, and to use the inversions of current to bring back the pens or markers without the aid of reacting springs. In this case the only modification of the apparatus required is in the disposition of the insulations and contacts necessary to transmit in their proper order the currents from the rheomotor into the two wires.

The third improvement is in the recording or printing apparatus, which

prints or impresses legible marks on a strip of paper, corresponding in their arrangement with the apertures in the perforated paper. The pens or styles are depressed and elevated by their connection with the moving parts of the electro-magnets; they are entirely independant of each other in their action, and are so arranged that when the current passes through the coils of the electro-magnets in one direction, one of the pens is depressed, and when it passes in the contrary direction the other pen is depressed; when the currents cease, light springs restore the pens to their usual elevated positions. The mode of supplying the pens with ink is as follows:—A reservoir about an eighth of an inch deep, and of any convenient length and breadth, is made in a piece of metal, the interior of which may be gilt in order to avoid the corrosive action of the ink placed in it. At the bottom of this reservoir are two holes, sufficiently small to prevent by capillary attraction the ink from flowing through them. The ends of the pens are placed immediately above these small apertures, which they enter when the electro-magnets act upon them, carrying with them a sufficient charge of ink to make a legible mark on the strip of paper passing beneath them. The motion of the paper ribbon is produced and regulated by apparatus similar to those employed in other register or printing telegraphs.

The electro-magnets described as the second improvement in my Provisional Specification bearing even date herewith, are well adapted to effect the motions of the pens of this instrument, but other means may be employed for this purpose.

Instead of reacting springs for restoring the position of the pens, the attractive or repelling force of small permanent magnets may be employed. All the essential parts of my new recording or printing telegraph are included in the previously mentioned three improvements. The following improvements are either auxiliary or substitutions for parts already mentioned.

The fourth improvement is an instrument which I call a translator; its object is to translate the telegraphic signs consisting of successions of points or marks adopted in this system into the ordinary alphabetic characters. In the system I have adopted, limiting the number of points in succession to four, 30 distant characters are represented.

The instrument presents externally nine finger stops, eight of which are arranged in two parallel rows, four in each, and the remaining one is placed separately.

The principal part of the mechanism within is a wheel, on the circumference of which 30 types are placed at equal distances, representing the letters of the alphabet and other characters; other mechanism is so disposed and connected

thereto, that when the keys of the upper row are respectively depressed, the wheel is caused to advance 1, 2, 4, or 8 steps or letters, and when those of the lower row are in like manner depressed, the wheel advances respectively 2, 4, 8, or 16 steps. By this disposition when the stops are touched successively in the order in which the points are printed on the paper, touching the first stop for one point, the first and second for two points, &c., and selecting the stops of the upper or lower row, according as the point is in the upper or lower row of the printed ribbon, the type wheel will be brought into the proper position for placing the letter corresponding to the succession of points over a ribbon of paper. The ninth stop when it is pressed down acts to impress the type on the paper to cause the advance of the paper, in order to bring a fresh place beneath the type wheel, and subsequently to restore the type wheel to its initial position.

The fifth improvement is a modification of the electro-magnets of the instrument of the third improvement, which enables the pens to go back to their normal positions, when the currents in the telegraphic circuit cease without the aid of reacting springs or permanent magnets. An extra coil of wire is wound round each of the electro-magnetic bars, which act on one side of each of the double magnetic needles, appropriated to the two pens. These coils are entirely insulated from those connected with the telegraphic circuit, and form together a short local circuit in which a feeble voltaic current continually circulates in consequence of the interposition of a small rheomotor; by this current the needles are held, when no current exists in the telegraphic circuit, constantly attracted towards these electro-magnets. When, however, the current transmitted through the telegraphic circuit acts on the coils, besides its direct action to cause the deflection of one of the double needles and the detention of the other, it neutralizes the current of the local battery in that electro-magnet, where its effect for the time would be disadvantageous.

The sixth improvement consists in the application of ribbons of paper prepared by the perforator, and passed through the transmitter as heretofore described, to produce the successive motions of a magnetic needle or needles, corresponding to the signals required, whether separately employed for this purpose, or in conjunction with the printing apparatus already mentioned.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed by the said Charles Wheatstone in the Great Seal Patent Office on the 2nd December 1858.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, CHARLES WHEATSTONE, of Hammersmith, in the County of Middlesex, send greeting.

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Second day of June, in the year of our Lord One thousand eight hundred and fifty-eight, in the twenty-first year of Her reign, did, for Herself, Her heirs and successors, give and grant unto me, the said Charles Wheatstone, Her special licence that I, the said Charles Wheatstone, my executors, administrators, and assigns, or such others as I, the said Charles Wheatstone, my executors, administrators, and assigns, should at any time agree with, and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "IMPROVEMENTS IN ELECTRIC TELEGRAPHS, AND IN APPARATUS CONNECTED THEREWITH," upon the condition (amongst others) that I, the said Charles Wheatstone, my executors or administrators, by an instrument in writing under my, or their, or one of their hands and seals, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

NOW KNOW YE, that I, the said Charles Wheatstone, do hereby declare the nature of the said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof, that is to say:—

My Invention consists of a new combination of mechanism for the purpose of transmitting through a telegraphic circuit messages previously prepared, and causing them to be recorded or printed at a distant station. Long strips or ribbons of paper are perforated by a machine constructed for the purpose, with apertures grouped to represent the letters of the alphabet and other signs. A strip thus prepared is placed in an instrument associated with a rheomotor (or source of electric power) which on being set in motion moves it along and causes it to act on two pins in such manner that when one of them is elevated the current is transmitted to the telegraphic circuit in one direction, and when the other is elevated it is transmitted in the opposite direction; the elevations

and depressions of the pins are governed by the apertures and intervening intervals. These currents following each other indifferently in the two opposite directions act upon a printing or writing instrument at a distant station, in such manner as to produce corresponding marks on a ribbon of paper moved by appropriate mechanism.

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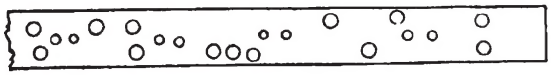

Figure 1 is a side view; Figure 2 an end view; and Figure 3 a plan of an instrument constructed according to this improvement; Figure 4 is a side view of the same, with the external case removed; Figure 5 is a view of the other side of the instrument; Figure 6 is a transverse section taken at the line 1, 2; Figure 4, *a*, *b*, and *c*, are three finger keys shown separately in plan at Figure 7, they are all mounted so as to turn freely on the same axis; on the end of each of these finger keys a punch rests, and these punches are marked *d*, *e*, and *f*, respectively; they are mounted in the rocking frame *g*, and are capable of sliding up and down through holes in the top and bottom bars of this frame. *h*, *h*, are the centres on which the frame *g* is mounted. The slip of paper to be perforated is passed through an opening at the top of the frame *g*, and

between it and the piece of steel *i*, which is attached by screws to the top of the frame *g*; in the piece *i* are three holes corresponding in size with the ends of the punches *d*, *e*, and *f*, and placed vertically over them, the centre hole is the smallest of the three to suit the reduced size of the end of the corresponding punch; the paper also passes under the spring clip *j*, which is attached to the piece *k* screwed to the top of the instrument. To the end of the spring clip *j* a cross piece is fixed, and under the ends of this cross piece two holes are bored in the top plate, and the upper ends of the wires *l*, *l*, fit into these holes; the wires *l*, *l*, are fixed at their lower ends into an angle piece *m*, and from this angle piece a stem m^1 projects downwards through a hole in the bottom plate of the instrument and serves to guide the angle piece in its up and down motions. When one of the finger keys is pressed down, the first effect is to force up the corresponding punch through the paper; the end of the key then comes in contact with the angle piece *m*, and lifting it causes the wires *l*, *l*, to relieve the pressure of the spring clip *j* on the strip of paper; afterwards, as the key still rises, its end comes in contact with the cross piece *n*, fixed to the rocking frame *g*, and causes it partially to rotate on its pivots *h*, *h*, until it is stopped by the end of the key coming in contact with the base of the instrument; during this motion the frame *g* carries the strip of paper forward with it; *o* is a projection from the frame *g*, and a spring rests on it, so as to act as a break and prevent any excess of motion of the frame. When the pressure on the key is removed, the angle piece *m* is pressed down by its springs *p*, *p*, and immediately allows the spring clip *j* to descend on the paper. At the same time one of the two projections *q*, *q*, from the angle piece *m*, pressing on collars on the punches *d*, *e*, and *f*, acts on the punch which was forced through the paper to draw it down, and as the key continues its return motion the angle piece *m* comes down on the cross piece *n*, and brings the frame *g* back to its original position. By this arrangement the punches can be caused to act to pierce the paper in any desired order, and between each action the paper will step a certain regular distance forward.

The second improvement consists of an apparatus which may be called the transmitter, the object of which is to receive the slips of paper prepared by the previously described instrument or perforator, and to transmit the currents produced by a voltaic battery or other rheomotor in the order and direction corresponding to holes perforated in the slip; this it effects by mechanism somewhat similar to that by which the perforator performs its functions. An excentric produces and regulates the occurrence of three distinct movements:—1st, the to-and-fro motion of a small frame, which contains a groove fitted to receive a slip of paper and to carry it forward by its advancing motion; 2nd,

the elevation and depression of a spring clip which holds the slip of paper firmly during the receding motion, but allows it to move freely during the advancing motion; 3rd, the simultaneous elevation of three wires placed parallel to each other resting at one of their ends on the axis of the excentric and their free ends entering corresponding holes in the grooved frame; these three wires are not fixed to the axis of the excentric, but each of them rests against it by the upward action of a spring, so that when a light pressure is exerted on the free end of either of them, it is capable of being separately depressed. When the slip of paper is not inserted and the excentric is in action, a pin attached to each of the external wires passes during each advancing and receding motion of the frame from contact with one spring into contact with another spring; and an arrangement is adopted, by means of insulations and contacts properly applied, by which, while one of the wires is depressed and the other remains elevated, the current passes from the voltaic battery to the telegraphic circuit in one direction, and passes in the other direction when the wire before elevated is depressed, and vice versa; but while both wires are simultaneously elevated or depressed, the passage of the current is interrupted. When the prepared slip of paper is inserted in the groove and moved onwards whenever the end of one of the wires enters an aperture in its corresponding row, the current passes in one direction, and when the end of the other wire enters an aperture of the other row it passes in the other direction. By this means the currents are made to succeed each other automatically in the proper order and direction to give the requisite variety of signals. The middle wire only acts as a guide to the paper during the cessation of the currents. The wheel which drives the excentric may be turned by hand or by the application of any motive power.

Figure 8 is a plan of an instrument arranged according to this improvement; Figure 9 is a plan of the same, with the cover removed; Figure 10 is a side view; Figure 11 is a longitudinal section; and Figure 12 is an end view. *a*, *a*, is the frame of the instrument, which is of brass, and mounted on a wooden base *b*; the frame *a* carries the axis *c* in bearings *d*; *e* is a handle fixed at the end of the axis *c*, by which it can be revolved by hand; at its further end the axis *c* carries a toothed wheel *f*, which drives a pinion *g* on the axis *h*, and at the other end of this axis, a fly wheel *i* is fixed; the axis *h* may either have an excentric mounted on it, or it may be cranked, as is shown in the Drawing; *j* is a moveable frame mounted on pivots *k*, *k*, it is shewn separately at Figure 12×; the three needles *l*, *m*, and *n*, pass through holes in the top of this frame; these needles are continued below the bottom bar of the frame and terminate in hooks, which pass round the crank on the axis *c*, and the

hooks of these needles are kept up in contact with the axis by the spiral springs *o*, *p*, and *q* respectively. The two outside needles *l* and *n* are furnished with bosses of ivory *r* and *s*, and to these bosses the springs *o* and *q* are attached by small screws, and these springs also serve for the passage of the electric currents or shocks, as will be hereafter explained; they are in metallic communication with the small pins *t* and *u* respectively. It will be seen that each time that the axis *c* revolves, its crank takes down with it all the three needles *l*, *m*, and *n*, and that when the crank moves to its highest position the needles rise with it (unless some impediment be interposed), the needles *l* and *n*, being drawn up by the springs *o* and *q*, and the needle *m* by the spring *p*; and in addition to the rising and falling motion of the needles, the crank causes the frame *j* to rock on its pivots *k*, *k*; this it does by coming against the two springs j^1, j^1, fixed to the two sides of the frame *j*. The motion of the frame is limited to the required extent by screw stops; each revolution of the axis *c* also lifts the needle *v*, so as to cause its upper end to press upwards the spring clip *w* and relieve its pressure. When the apparatus is in action the slip of paper *x*, punctured as already described, is placed between guides at the top of the instrument passed through the opening in the top of the frame *j*, and then under the clip *w*; then each time that the needles *l*, *m*, and *n*, are allowed to rise, one of them enters a perforation in the slip of paper *x*; the upper end of the frame *j* then immediately begins to move forward (turning on its pivots *k*, *k*,) and it carries with it the slip of paper, the needle *v* lifting the spring clip *w* at the same time. When the upper end of the frame has arrived at the end of its forward course the needles *l*, *m*, and *n*, are drawn down and at the same time the needle *v* allows the spring clip *w* to descend on to the slip of paper so as to nip it firmly; the frame *j* then recedes, and the operation is repeated, one of the needles rising into the next hole of the strip. The pins *t* and *u*, carried by the needles *l* and *n*, by means of the wires *y*, *y*, which pass to binding screws, are brought in connection with the poles of a voltaic battery or other source of electric power, and the currents or shocks, proceed to the pins *t* and *u*, by the pieces *z*, *z*, (which are insulated from the frame) and the springs *o* and *q*. When the pins *t* and *u*, are kept down by the interposition of the paper, or are drawn down by the crank, they rest on springs A, A, both in connection with a piece of metal insulated from the frame and in connection with the line wire; but when either of the pins *t* or *u*, with its corresponding needle, is allowed to rise, it passes out of contact with the spring A on which it rested, into contact with one of the springs B, B, both of which are in electric communication with the earth; thus, according as one or other of the needles *l* and *n*, is allowed to rise by the perforations in the strip of paper, so

will the battery or other source of electric power be brought into the circuit so as to communicate a shock or current in one or other direction.

In place of connecting the pins *t* and *u* with the battery and the springs A, A, and B, B, with the line wire and the earth, this arrangement may be reversed, and the pins *t* and *u* be connected with the line wire and the earth respectively, and the springs A, A, and B, B, with the battery poles.

Sometimes, in place of transmitting battery currents or shocks by this instrument, I transmit currents induced by a voltaic battery; and, in this case, I connect the terminal wires of the induction coil to the instrument, in lieu of the battery terminals, and I add to the instrument the parts shown in red lines in the Drawing, for the purpose of breaking the battery circuit of the induction instrument, whilst the needles are divided by the strip of perforated paper. The action of these parts is as follows:—C is a bell-crank lever, the end of which, when in contact with the screw carried by the standard D, completes the battery circuit of the induction apparatus; the current passing from the binding screw E to the standard D, thence by the lever C to the frame of the instrument which is in connection with the binding screw F; the circuit is broken at the time required by the crank on the axis *h* coming in contact with the tail of the lever C; the return motion of this lever is produced by a spring.

Instead of a voltaic battery, a magneto-electric or an electro-magnetic machine may be employed as the source of electric power. In this case, the transmitter and the magneto-electric or electro-magnetic machine form a single apparatus moved by the same power, and they are so adapted to each other, that the shocks or currents are produced at the moments the pins of the transmitter enter the apertures of the perforated paper.

Figure 13 is a longitudinal section of a transmitter combined with a magneto-electric machine, so as to work with the shocks or currents produced by it in place of those produced by a battery. *a* is an axis, which is turned by hand or otherwise; *b* is a toothed wheel mounted on this axis, and driving a pinion *c* carried by the axis *d*. This pinion is not fixed on its axis, but has ratchet teeth formed on it, and these are kept up in contact with similar ratchet teeth on an enlargement of the axis *d* by the spiral spring *e*. Thus, if the axis *a* should be turned in the wrong direction, it does not drive the axis *d*. *f* is a toothed wheel fixed on this axis, and which drives the pinion *g* on the axis of the armature *h*, which is thus caused to revolve in front of the poles of the permanent magnet *i*, part of which is removed, so that the apparatus behind it may be seen. The armature *h* is surrounded with coils in the usual manner, and the ends of these coils are connected with two pieces

of metal *j* and *k* let into the insulating wheel of ivory *l*. This wheel is mounted on the axis which carries the armature, and is embraced by the two springs *m* and *n*, insulated from each other, and connected with the transmitter in the same manner as the battery poles are connected with that instrument when a battery is employed, as already described. It will be seen that the currents or shocks produced by the magneto-electric machine enter the springs marked *n* always in the same direction. The transmitter is not shewn complete in this Drawing, for it has already been fully described. The axis *o* corresponds with the axis *h* of Figures 9, 10, 11, and 12 and it is here driven so as to make two revolutions while the armature makes one, there being a toothed wheel mounted on the armature axis, and a pinion on the axis *o*, as is shewn by the Drawing. The transmitters just mentioned require only a single wire of communication, and currents in both directions are available for printing the signals; but in some cases it may be advantageous to employ two telegraphic wires, and to use the inversions of current to bring back the pens or markers without the aid of reacting springs. In this case the only modification of the apparatus required is in the disposition of the insulations and contacts necessary to transmit in their proper order the currents from the rheomotor into the two wires.

Figure 14 is a perspective view of a transmitter arranged to work with two line wires; in this instrument, besides the necessary change in the insulations and contacts, the mechanical arrangements are slightly varied, the construction shown being more convenient when two line wires are employed than that first described. *a* is a permanent magnet, and *b* is an armature mounted on an axis *c*, so as in revolving to pass in front of the poles of the magnet. On the axis *c* there is a toothed wheel *d*, which drives the pinion *e* on the vertical axis *f*, so that this axis makes twice as many revolutions as the axis *c*; at the upper end of the axis *f* is a cam *g*, arranged to act on the pin *h*, which is mounted on a rocking frame similar to the rocking frame of the transmitter already described. The pin *h* is kept in contact with its cam *g* by a spring *i*. The form of the cam is such that the forward motion of the frame is gradual, but its return motion takes place as rapidly as the spring *i* will react. *j* is another cam on the axis *f*; it comes in contact with a projection on the lever *k* just as the return motion of the rocking frame is going to take place, and so causes this lever to draw down the three needles carried by this frame. At the same time the tail of the lever *k* presses on the end of another lever *l*, which is fixed to the spring clip *m*, and so causes the clip, by turning slightly on its axis, to nip the paper under it. It will be seen that the two outside needles carried by the rocking frame have projections from

their lower ends, and when they are allowed to rise by the perforated paper, as before explained, their ends come in contact with the springs *n* and *o*, which are insulated from the rest of the instrument, and are in communication with the two line wires. On the axis *c* a metal disc is mounted; it is made in two parts *p* and *q*, which are insulated from each other and from the axis. *r* and *s* are two springs, which press on the periphery of the disc as it revolves; the spring *r* is in metallic communication with the working parts of the instrument, and the spring *s* is insulated from these parts, but is put into metallic connection with the earth. When one of the needles of the rocking frame comes into contact with its corresponding spring *n* or *o* it brings the line wire in connection with the spring into metallic communication with the working parts of the instrument, and any currents or shocks transmitted to these flow into the line wire. From the construction of the apparatus, the contact between the needles of the rocking frame and their corresponding springs when established lasts during half a revolution of the axis *c*, and in this period two currents in opposite directions are transmitted into the line wire. The first current acts to bring one of the pens or markers of the receiving instrument into contact with the surface to be marked, and the second current to bring this pen or marker to its original position. It is evident that, if necessary, the instrument above described may be worked with one line wire only, without any change being made in the instrument; all that is necessary is, that in perforating the strip for the message, only one of the outside finger keys of the perforator should be employed (the alphabet or signs employed being modified accordingly). Or the perforating instrument and the transmitting instrument may both be modified, if desired, so as to be suitable only for working with one line wire by constructing the perforator with two in place of three finger keys and punches and the transmitter with two in place of three needles.

The third improvement is in the recording or printing apparatus, which prints or impresses legible marks on a strip of paper, corresponding in their arrangement with the apertures in the perforated paper. The pens or styles are depressed and elevated by their connection with the moving parts of the electro-magnets; they are entirely independent of each other in their action, and are so arranged, that when the current passes through the coils of the electro-magnets in one direction, one of the pens is depressed, and when it passes in the contrary direction, the other pen is depressed; when the currents cease, light springs restore the pens to their usual elevated positions. The mode of supplying the pens with ink is as follows:—A reservoir, about an eighth of an inch deep, and of any convenient length and breadth, is made in a

piece of metal, the interior of which may be gilt, in order to avoid the corrosive action of the ink placed in it; at the bottom of this reservoir are two holes, sufficiently small to prevent by capillary attraction the ink from flowing through them; the ends of the pens are placed immediately above these small apertures, which they enter, when the electro-magnets act upon them, carrying with them a sufficient charge of ink to make a legible mark on the strip of paper passing beneath them. The motion of the paper ribbon is produced and regulated by apparatus similar to those employed in other register or printing telegraphs.

The electro-magnets described as the second improvement in the Specification of my Patent, bearing even date herewith, are well adapted to effect the motions of the pens of this instrument, but other means may be employed for this purpose. Instead of reacting springs for restoring the position of the pens, the attractive or repelling force of small permanent magnets may be employed. Figure 15 is a plan of a recording or printing apparatus constructed according to my Invention; Figure 16, a side view, with part of the case removed; Figure 17, a longitudinal section, taken at the line 1, 2, Figure 15; Figure 18 is a transverse section taken at the line 3, 4; Figure 15 and Figure 19 is an end view (with part of the case removed) of the same; *a*, *b*, *c*, *d*, and *e*, *f*, *g*, *h*, represent two sets of electro-magnets, there being four magnets in each set; the coils of these magnets are all in connection with the line wire, and the wires are so arranged, that if a shock or current in passing gives a north polarity to one of the magnets, it at the same time gives a south polarity to the adjacent extremities of the two electro-magnets next to it. In the centre of these sets of electro-magnets axes *i* and *j* are mounted, so as to turn freely on suitable pivots; to each of these axes four curved magnetic needles or bars are fixed, marked respectively *k*, *k*, *k*, *k*, and *l*, *l*, *l*, *l*. These magnetic needles or bars are kept at their extreme positions in one direction by the attraction of the permanent magnet *m*, or, for this magnet, light springs may be substituted. On the ends of the axes *i* and *j* are mounted styles or pens of bent wire *n* and *o*, carefully balanced about their axes; when no current or shock is passing in the coils, both the pens are maintained at their highest position by the attraction of the magnet *m*, but when a current or shock passes, it causes the electro-magnets of one set so to attract and repel their magnetic needles or bars, as to cause the axis on which they are mounted to rotate, and the point of the pen mounted on it to descend. The magnetic needles or bars of the other set of electro-magnets, together with the corresponding axis and pen, remain stationary, the influence of the electro-magnets only being to force the pen against a stop, which prevents its rising. When the pens descend, they

pass through holes in the bottom of the ink reservoir *p*, of which several detached views are shown at Figures 20; it slides on to the top of the standard *q*, and is held in position by the catch *r*; the slip of paper to receive the marks passes under the reservoir, through the opening *s*, and is drawn regularly forward by clockwork. When the instrument is at work, the hollow of the reservoir is filled with ink, and the pens in descending carry down sufficient to mark the paper legibly, as is shown at Figure 21. I would here remark, that the ends of the pens should be filed perfectly flat, also, that for convenience, the pens are not permanently fixed on their axes, but are fixed to a small tube *t*, the end of which is notched, and a pin on the axis drops into the notch, the tube being forced up to it by a spring *u*; this enables the pens being turned up out of the way, if desired, for the purpose of removing the reservoir when it requires to be cleaned. In order that the apparatus above described may be used with two line wires, as when the transmitter, shown at Figure 14, is employed, it is not necessary that any change should be made in the construction of the instrument, but only that the connecting bar *v*, which carries the currents or shocks from one to the other of the two sets of magnets *a*, *b*, *c*, *d*, and *e*, *f*, *g*, *h*, should be removed, and that the connections should be so made as to put one of the sets of magnets into circuit with one line wire, and the other set with the other wire. A single line recording or printing apparatus may be constructed to work in this manner, such instrument having but one set of magnets *a*, *b*, *c*, *d*, and a single pen, which, by passing down into a reservoir of ink, and through a hole in the bottom of the reservoir, produces dots on a strip of paper beneath in the manner already described as forming part of my Invention. All the essential parts of my new recording or printing telegraph are included in the previously mentioned three improvements. The following improvements are either auxiliary or substitutions for parts already mentioned.

The fourth improvement is an instrument which I call a translator. Its object is to translate the telegraphic signs, consisting of successions of points or marks, adopted in this system, into the ordinary alphabetic characters. In the system I have adopted, limiting the number of points in succession to four, 30 distinct characters are represented. The instrument presents externally nine finger stops, eight of which are arranged in two parallel rows, four in each, and the remaining one is placed separately. The principal part of the mechanism within is a wheel, on the circumference of which 30 types are placed at equal distances, representing the letters of the alphabet and other characters; other mechanism is so disposed and connected thereto, that when the keys of the upper row are respectively depressed, the wheel is caused to

advance 1, 2, 4, or 8 steps or letters, and when those of the lower row are, in like manner, depressed, the wheel advances respectively 2, 4, 8, or 16 steps. By this disposition, when the stops are touched successively in the order in which the points are printed on the paper, touching the first stop for one point, the first and second for two points, &c., and selecting the stops of the upper or lower row, according as the point is in the upper or lower row of the printed ribbon, the type wheel will be brought into the proper position for placing the letter corresponding to the succession of points over a ribbon of paper. The ninth stop, when it is pressed down, acts to impress the type on the paper, to cause the advance of the paper, in order to bring a fresh place beneath the type wheel, and subsequently to restore the type wheel to its initial position.

Figure 22 is a plan of the translator with some of the parts removed; Figure 23 is a left-hand side view; Figure 24 is a right-hand side view; Figure 25 is an under side view; Figure 26 is an end view; Figure 27 is a horizontal section taken at the line A, A, Figure 23; Figure 28 is a transverse section taken at the line A, A, Figure 22; and Figure 29 is also a transverse section taken at the line B, B, of the same Figure.

Figure 30 is a plan of the case of the instrument. a is the type wheel, which carries thirty steel types or punches a^1, a^1, having letters or characters engraved on their lower ends; the type wheel a is shown separately at Figures 31, 32, and 33 in plan, longitudinal section, and side view respectively. a^2, a^2, are two metal discs, through holes in which the types or punches a^1 pass. Each of the types or punches has a small pin fixed in it, and projecting inwards towards the centre of the type wheel. a^3 is a metal disc mounted loosely on the centre of the type wheel, and kept up to the upper disc a^2 by a spiral spring. The pins of the types or punches rest on the disc a^3, and are thus held up by it, but it will allow any one of the types or punches to descend into contact with the wheel a^4, when it is pressed on with sufficient force to overcome the spiral spring, and if a strip of paper is inserted between the type or punch and the wheel a^4, it will become printed or embossed with the character engraved on the type or punch. The type wheel a is connected with clockwork, which causes it to revolve whenever it is allowed to do so. This clockwork consists of the following parts:—b is a spring barrel; b^1 is a chain, by which the barrel b gives motion to the fuzee b^2; b^3 is a toothed wheel mounted on the axis of the fuzee, it drives a pinion b^4, and a toothed wheel b^5 carried by the same axis gives motion to a pinion b^6, and in this manner, by other wheels b^7 and b^8, the wheel b^9 is driven, and this gears directly with teeth formed in the periphery of the wheel a^4. The teeth of this wheel correspond in number with the types or punches which the type wheel carries.

When the instrument is at rest the type wheel is prevented revolving by a bolt *c*, the end of which rests against a projection a^5 on the under side of the wheel a^4. The bolt *c* passes up through the bottom plate of the instrument, and through guides above; it is capable of moving longitudinally a short distance when actuated by the finger keys, as is herein-after described. d^1, d^2, d^3 and d^4 are the finger keys in the upper row, which produce respectively when pressed down 1, 2, 4, and 8, steps of the type wheel, and d^5, d^6, d^7, and d^8 are the finger keys in the lower row, which produce respectively 2, 4, 8, and 16 steps of the type wheel.

I will proceed in the first place to trace the motions produced by pressing down the key d^5, for in using the instrument either this key or the key d^1 is in all cases first depressed at the commencement of every letter. The lower end of the key d^5 rests on the lever e^1, which turns on centres f^1, f^1; as this lever turns, it, by a fork formed on one of its arms, draws down the bolt *c* against the pressure of the spring c^1, but before the bolt gets clear of the projection a^5 another arm of the lever e^1 raises up the axis g^1 against the pressure of the spring h^1, so as to bring the segment g^2 mounted on it into gear with the wheel a^4, and to avoid friction, the pressure of the spring h^1 is relieved at this time by the pin i^1, which passes through both the top and bottom plates of the instrument, resting at one end on an arm of the lever e^1 and at the other end on the under side of the spring h^1, so that when the pin i^1 is pushed upwards by the motion of the lever e^1 it relieves the pressure of the spring h^1 on the axis g^1; this axis is limited in its rotatory motion by having an arm g^3 mounted on it, which is placed between two stops on the bottom plate, so that the segment g^2 mounted on the axis can only turn through a space equivalent to two steps of the type wheel, and when the bolt *c* is entirely withdrawn the type wheel moves through this space. g^4 is a slight spiral spring, which ensures the arm g^3 being in contact with its stop at the commencement of its partial rotation at the time when the segment g^2 is thrown into gear with the wheel a^4. When the key d^5 is allowed to rise by the action of its spiral spring before the segment g^2 is pushed out of gear by the return of the spring h^1 a catch not yet described falls into the teeth of the wheel a^4, and retains it; this catch is marked *j* in the Drawing, and it operates at all times to retain the type wheel when the finger keys *d* are not depressed, except when the printing finger key *k* has been last depressed, and then the catch *j* is thrown out of action, and the type wheel *a* is only prevented from revolving continuously by the bolt *c*, as already described.

After the key d^5 either the key d^2 or d^6 would in working the machine be depressed (if more than one dot is required to indicate the letter to which

it is desired to bring the type wheel); but before describing the action of these keys I will describe that of the key d^1:—Its lower end rests upon the end of the lever e^2, which turns on centres f^2, f^2; the other end of this lever passes under the lever e^1, so that by depressing the key d^1 the lever e^1 is worked just as if the key d^5 were depressed, and the motions produced are the same, except that the segment g^2 is limited in its partial revolution to an arc corresponding to a motion of one tooth of the wheel a^4 (in place of to an arc corresponding to a motion of two teeth, as when the key d^5 is depressed,) this further limitation of the motion is effected by a stop l fixed on the lever e^2, and passing upwards through a hole in the bottom plate, and when the key d^1 is pressed down the stop l is brought into such a position that the arm g^3 comes against it when the axis g^1 has rotated to the extent required. When the key d^2 is depressed it comes in contact with the rocking frame m (as indeed do all the other keys d when they are depressed); this frame is mounted on centres m^1, m^1, and when acted on by the key it presses downwards, the bar n overcoming the spring n^1, this bar is carried by the arms n^2, n^2, fixed on the axis n^3. n^4, n^4. are the centres on which this axis turns, and n^5 is an arm descending from it through the top plate of the instrument, and passing between the prongs of the fork j^1 attached to the catch j; thus the arm n^5 serves when motion is given it by depressing the key d^2, to lift the catch j out of the teeth of the wheel a^4, but before this wheel is released the lower end of the key d^2 has by pressing on the lever a^1 raised the segment g^2 into gear with the wheel a^4: thus by depressing the key d^2 the type wheel is moved two steps, just as when the key d^5 is depressed. When the key d^6 is pressed down, the catch j is raised as before, and at the same time the end of the key gives motion to the lever e^3, on which it presses, and this moves upwards the axis o^1 against the pressure of the spring h^2, so as to bring the segment o^2 mounted on it into gear with the wheel a^4, the pressure of the spring h^2 is relieved at this time by the pin i^2 in the same manner as the pressure of the spring l^1 on the axis g^1 is relieved when the key d^1, d^2, or d^5 is depressed.

The parts in connection with the axis o^1 are in all respects similar to those in connection with the axis g^1, except that the axis o^1 is by the stops which limit its motion, allowed to revolve when it is thrown into gear with the wheel a^4 through a space corresponding to four teeth of this wheel. The key d^3, when it is acted on, also moves the lever e^3, and produces motions in all respects similar to those produced by the key d^6. The keys d^4 and d^7 act on the lever e^4, and this raises an axis p^1 carrying a segment p^2, and otherwise arranged similarly to the axes g^1 and o^1, except that the axis p^1 is by its stops

allowed to rotate to an extent corresponding with 8 teeth of the wheel a^4. The key d^8 acts on the lever e^5, and raises an axis q^1 with parts in connection with it (similar to those with which the axes g^1, o^1, and p^1 are furnished), and the stops in connection with this axis are so arranged as to allow it to rotate to an extent corresponding with 16 teeth of the wheel a^4.

It will be remarked, that by means of the finger keys d, that is to say, by depressing first the key d^1 or d^5 next (if necessary), the key d^2 or d^6, then the key d^3 or d^7, and lastly, the key d^4 or d^8, any number of steps from 1 to 30 may be given to the type wheel a. When in this manner the required number of steps has been given to the type wheel, the printing finger key k is pressed down, and its end descends on to the upper end of the type or punch a^1 which has been brought under it, and it forces the face of the type or punch on to a strip of paper r placed between it and the wheel a^4, and the letter is thus stamped on the paper; this strip of paper enters the apparatus by the tube s, and issues from it by the tube s^1. The lower end of the key k has a projection k^1 formed on it, which rests between the ends of the two levers t and u, which are loosely jointed together, as is shewn, they turn respectively on the centres t^1 and u^1; at the end of the lever t is a driver t^2, which acts on the teeth of the wheel v; each time that the key k is depressed, the driver t^2 drops into a fresh tooth of the wheel v, being set into it by the small spring t^3, and when the key k is allowed to rise, it causes the wheel v partially to rotate, and with it the roller v^1, against which the strip of paper is pressed by the under roller v^2 carried by the spring v^3, in this manner the strip of paper is caused to make a step forward after each letter is printed. The lever u is for the purpose of bringing the type wheel back to the starting point after printing, this it does by raising the rod u^2 which carries the spring catch u^3, overcoming the pressure of the spring u^4, when the spring catch u^3 is raised it passes over the tail j^2 attached to the catch j, and when the key k again rises, the spring u^4 overpowers the spring j^3 on which the axis j^4 of the catch j rests, and draws this catch down below the level of the teeth of the wheel a^4, which, being then free, revolves until the projection a^5_j comes against the bolt c. In order to prevent the type wheel recoiling when thus suddenly stopped, a disc a^6 is mounted on its axis, and this disc has 30 small teeth formed on its edge, against which a spring a^7 presses, and this gives the type wheel a tendency to remain stationary when it is stopped opposite one of the letters.

All the parts have now been described which are essential to the translator; but as shewn in the Drawing, there is apparatus attached to it by which the instrument while translating a message is caused to transmit electric currents,

which, by acting on a receiving instrument at a distant station, there reproduce the message. w is a piece of ivory fixed to the bottom plate, it carries four insulated metal springs, w^1, w^2, w^3, and w^4, of which two are connected to the poles of a battery, one to the telegraphic line wire, and one to the earth; x is another piece of ivory carried by an arm m^2, fixed on the axis of the rocking frame m, and descending downwards through the top plate of the instrument, thus, each time that one of the finger keys d is depressed, the piece of ivory x is moved either in one direction or the other; the piece x has four pieces of metal y, y, mounted on its face, and four others y^1, y^1 on its back. The pieces of each of these sets y and y^1 are separately attached to the ivory piece x, but they are connected together in pairs by metallic coupling pieces y^2, y^2, and at each motion of the piece x one or other of these sets y or y^1 is brought in contact with the springs w^1, w^2, w^3, and w^4, and in consequence of the manner of arranging the coupling pieces y^2, y^2, one pole of the battery becomes connected with the line wire, and the other with the earth; but the direction in which the current proceeds depends on whether the piece x has been moved in one or other direction.

The fifth improvement is a modification of the electro-magnets of the instrument of the third improvement, which enables the pens to go back to their normal positions when the currents in the telegraphic circuit cease without the aid of reacting springs or permanent magnets. An extra coil of wire is wound round each of the electro-magnetic bars, which act on one side of each of the double magnetic needles appropriated to the two pens. These coils are entirely insulated from those connected with the telegraphic circuit, and form together a short local circuit in which a feeble voltaic current continually circulates, in consequence of the interposition of a small rheometor; by this current the needles are held when no current exists in the telegraphic circuit constantly attracted towards these electro-magnets. When, however, the current transmitted through the telegraphic circuit acts on the coils, besides its direct action, to cause the deflection of one of the double needles and the detention of the other, it neutralizes the current of the local battery in that electro-magnet, where its effect for the time would be disadvantageous.

In carrying out this part of my Invention, I place round each of the electro-magnets, exterior of the coils, in connection with the telegraphic line wire another coil formed of the same or of thicker wire than that employed for the telegraphic coils, and covered with silk in a similar manner; this second wire is wound once only from end to end of each of the magnets, and the spirals (so formed) on the different magnets are coupled up together, and

connected to a battery in such manner that the current passing in the spiral so magnetizes the soft iron cores of the magnets as to cause them, by attracting the magnetic needles, to draw both the pens to their highest position. Any battery of small power may be employed, and in order exactly to adjust the force of the current, so that on the one hand the rapid lifting of the pens may be ensured, and on the other hand that the current may not oppose too much resistance to the action of the currents which pass in the telegraphic circuit, I employ a well known instrument called a rheostat to regulate the amount of resistance in the local circuit.

The sixth improvement consists in the application of ribbons of paper prepared by the perforator, and passed through the transmitter, as hereinbefore described, to produce the successive motions of a magnetic needle or needles corresponding to the signals required, whether separately employed for this purpose, or in conjunction with the printing apparatus already mentioned. In carrying out this part of my Invention, I prefer to employ as the receiving instrument an ordinary single needle instrument, or a double needle instrument, of which both the coils have been placed in circuit with the single line wire, and the motions of the needles limited by suitable stops to one side of the axis only, and the strip of paper may be so perforated, as in its passage through the transmitter to produce motions of the needle or needles of the receiving instrument, similar to those which would be produced were the message transmitted by hand in the usual manner. The transmission may in this manner be effected more rapidly than can otherwise be effected, because an exact uniformity is obtained in the duration of the signals and of the intervals between them.

In witness whereof, I, the said Charles Wheatstone, have hereunto set my hand and seal, this Twenty-ninth day of November, in the year of our Lord One thousand eight hundred and fifty-eight.

C. WHEATSTONE. (L.S.)

Witness,

JNO. ALCOCK.

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Printers to the Queen's most Excellent Majesty. 1858.

Auf Tafel I, Fig. 5 und 7.
" " II. Fig. 9 und 12.

FIG. 4.

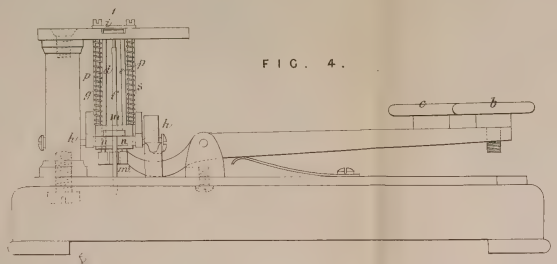


FIG. 5.

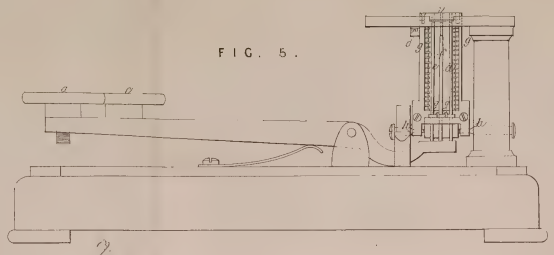


FIG. 1.

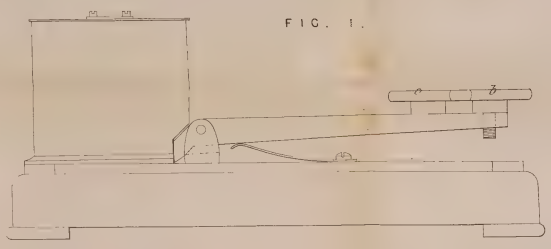


FIG. 2.

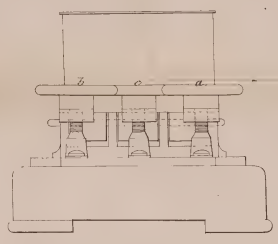


FIG. 6.

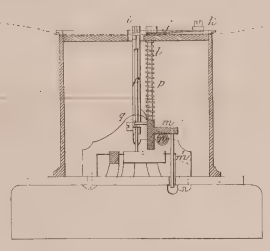


FIG. 3.

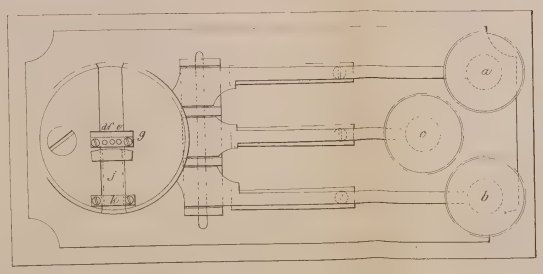
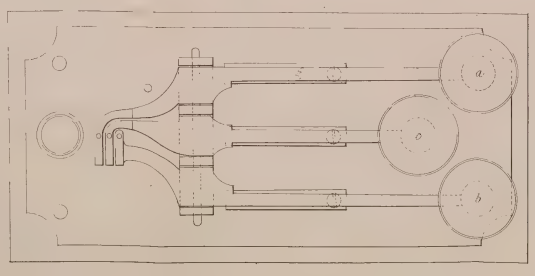


FIG. 7.



The first drawing is coloured.

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FIG. 8.

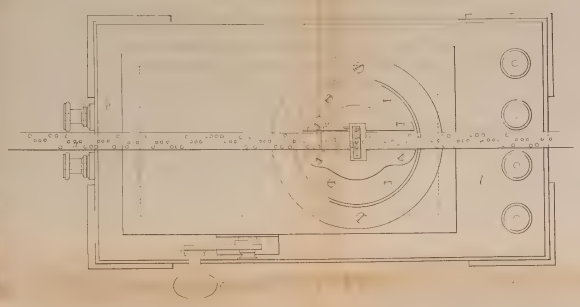


FIG. 9.

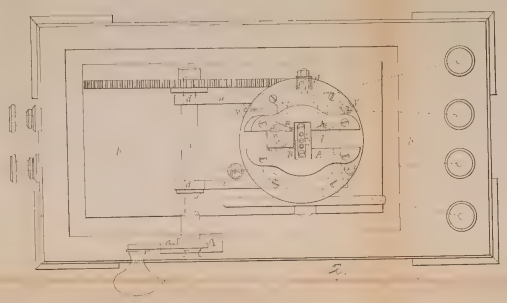


FIG. 12.

FIG. 10.

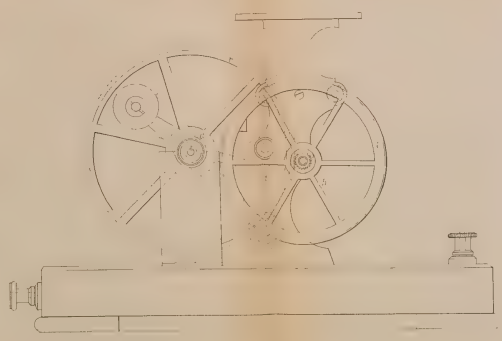


FIG. 11.

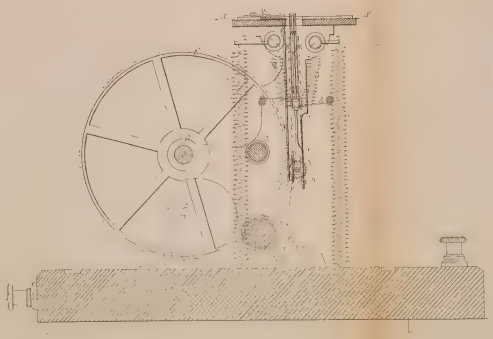
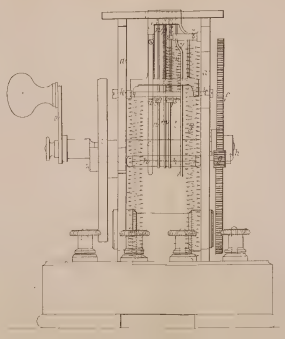


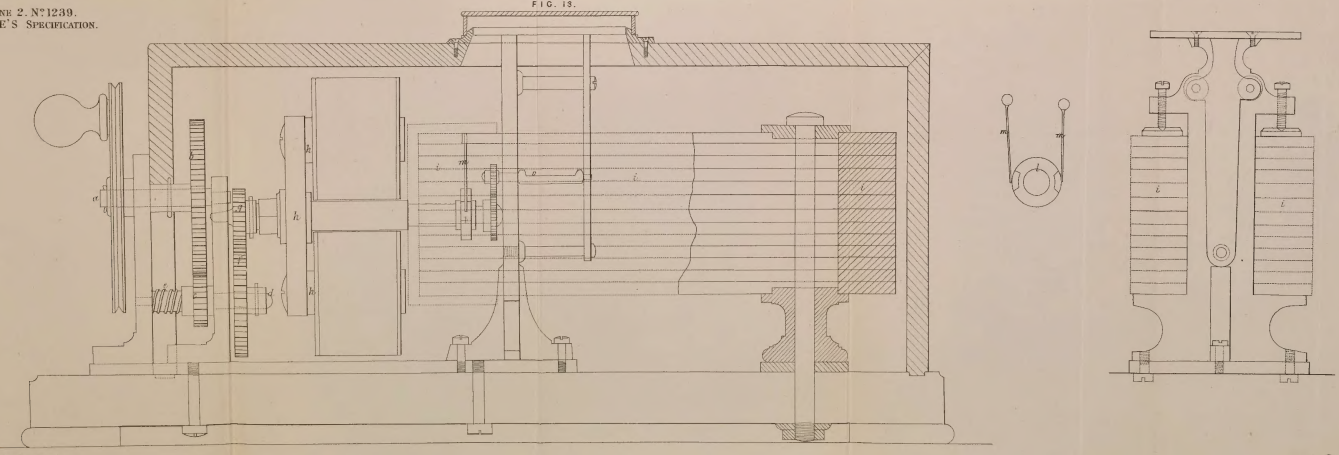
FIG. 12.



A.D. 1858. JUNE 2. N° 1239.
WHEATSTONE'S SPECIFICATION.

FIG. 13.

(6 SHEETS)
SHEET 3.



The filed drawing is colored.

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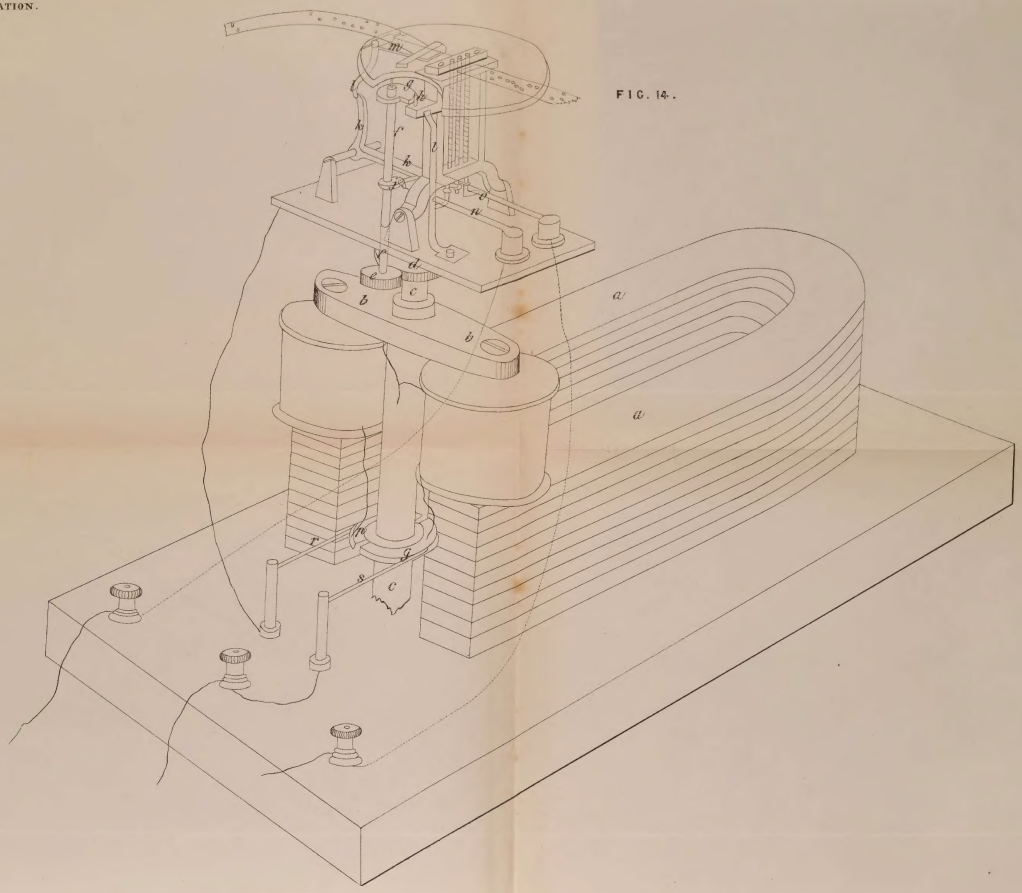
FIG. 14.



The filed drawing is colored.

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A.D. 1858. JUNE 2. Nº1239.
WHEATSTONE'S SPECIFICATION.

(6 SHEETS)
SHEET 5

FIG. 15.

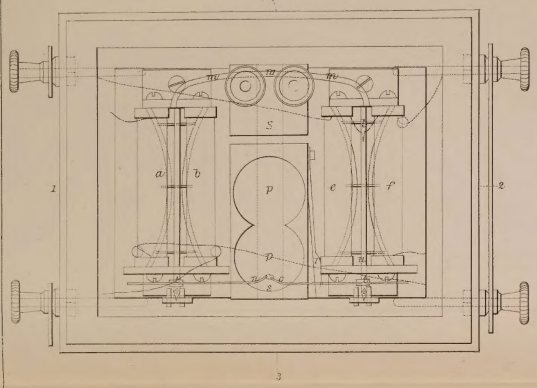


FIG. 18.

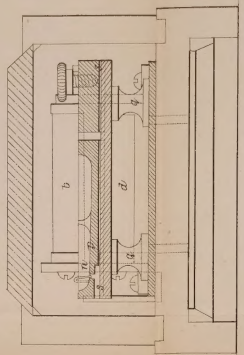


FIG. 19.

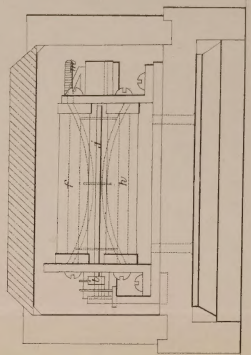


FIG. 20.

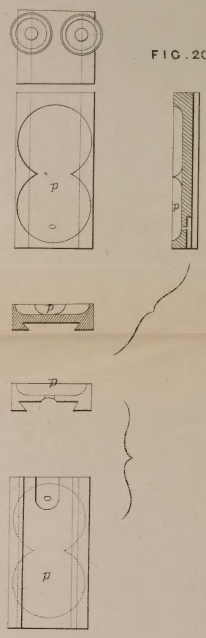


FIG. 21.

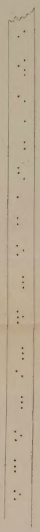


FIG. 16.

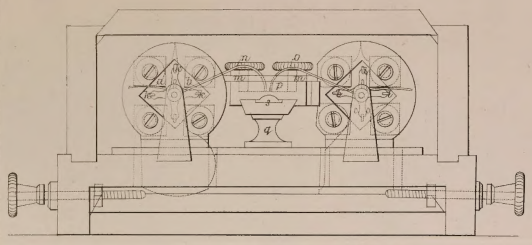
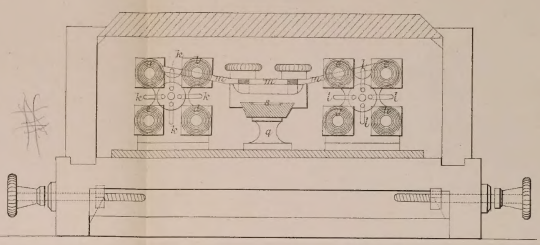


FIG. 17.



The filed drawing is colored.

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FIG. 22.

Plan with some of the parts removed

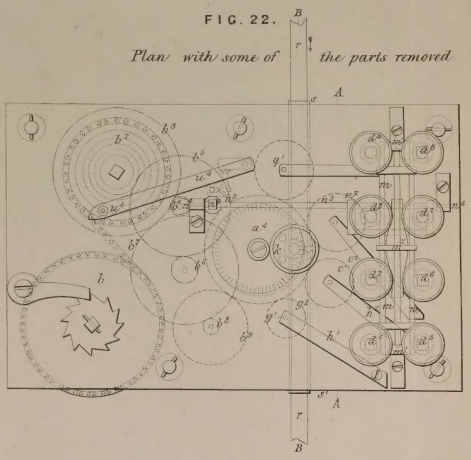


FIG. 23.

Left hand Side View

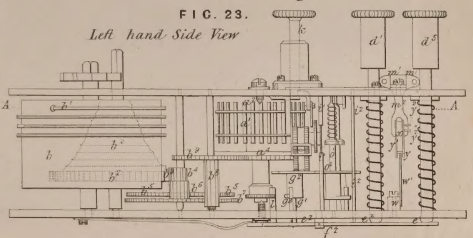


FIG. 27.

Horizontal Section

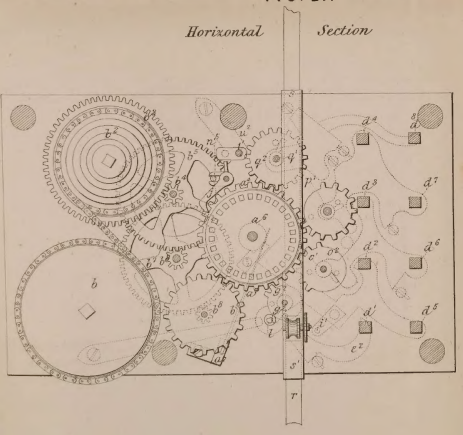


FIG. 26.

End View

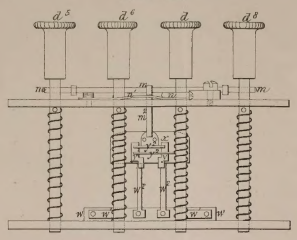


FIG. 28.

Section taken at the dotted line A, A, in Plan, Fig. 22.

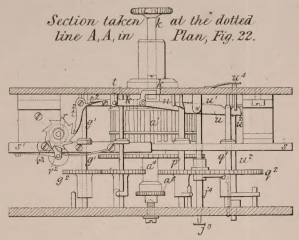


FIG. 29.

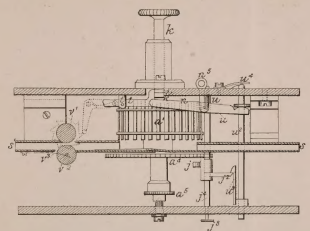


FIG. 31.

FIG. 32.

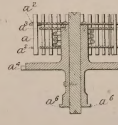


FIG. 33.

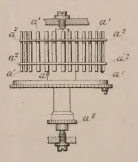


FIG. 24.

Right Hand Side View

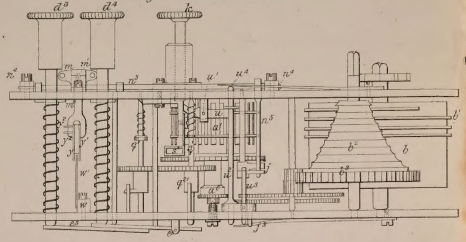


FIG. 25.

Underside View

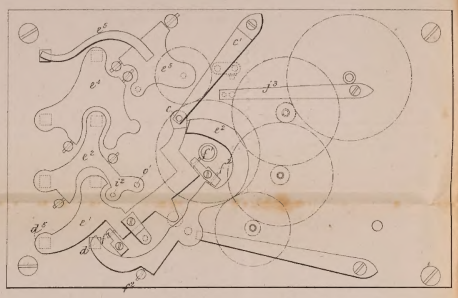
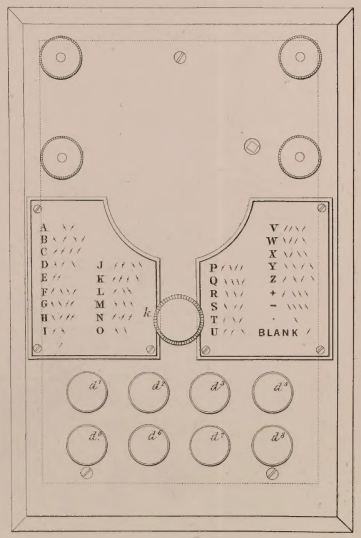


FIG. 30.



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